# PAUL JOSEPH STEINHARDT


## Address

Department of Physics
Jadwin Hall
Princeton University
Princeton, NJ 08544-0708


## Professional History

**Princeton University**

Albert Einstein Professor in Science, 2001-
Professor of Physics, 1998-2001
Associated Faculty, Department of Astrophysical Sciences, 1998-

Associate Director and Senior Fellow, 2006-
Princeton Center for Theoretical Physics

**University of Pennsylvania, Department of Physics**

Mary Amanda Wood Chair Professor, 1989-1998
Professor of Physics, 1986-89
Associate Professor of Physics, 1983-86
Assistant Professor of Physics, 1981-83

**Harvard University, Society of Fellows**

Junior Fellow, 1978-81

## Education:

1978 - Ph. D., Physics, Harvard University
1975 - M. A., Physics, Harvard University
1974 - B. S., Physics, California Institute of Technology

## Other Professional Positions

Keck Distinguished Visiting Professor, Institute for Advanced Study, Princeton; 2003-4
Editor, Physics Series, Princeton University Press, 1999 -
Visiting Faculty (Dyson Fellowship), Institute for Advanced Study, Princeton; January, May 1995
Visiting Faculty, Institute for Theoretical Physics, Santa Barbara CA; February-April, 1995
Consultant, IBM Research Laboratories, Yorktown Heights, NY; 1978-91
Visiting Faculty (Monell Fellowship), Institute for Advanced Study, Princeton; September, 1989 - March, 1990
Visiting Faculty, Institute for Advanced Study, Princeton; January-March, 1985
Visiting Faculty, T. J. Watson Research Laboratory, Yorktown Heights, NY; August-December, 1984
Visiting Professor, Department of Physics, Johns Hopkins University; Spring, 1983
Visiting Scientist, Theory Group, Stanford Linear Accelerator Center; July, 1980
Visiting Scientist, Department of Physics, Tel-Aviv University, Tel-Aviv, Israel; December, 1979-January, 1980
Visiting Scientist, C.E.R.N. Laboratory, Theory Group, Geneva, Switzerland; August, 1979
Visiting Scientist, Department of Physics, Princeton University, January-May, 1979

## Professional Organizations

Fellow, American Physical Society
Sigma Xi
American Astronomical Society
National Academy of Sciences

## Honors and Fellowships

Einstein Colloquium, Weizmann Institute, 2006
Distinguished Lecture Series, Technion, 2006
Simons Foundation Distinguished Lecturer, SUNY at Stony Brook, October, 2004
McMaster Colloquium in Cosmology, U. of Toledo, October, 2004
Keck Distinguished Visiting Professor, Institute for Advanced Study, 2003
P.A.M. Dirac Medal of the International Centre for Physics, 2002
Joseph and Sophia Konopinski Memorial Lecture in Physics, Indiana University, February, 2002
Colloquium Ehrenfestii, Leiden University, September 6, 2001
PASCOS Public Lecture, April, 2001
Boris Jacobson Lecturer, U. of Washington, May, 2000

Member, National Academy of Sciences, 1998-
Inaugural C.I.T.A. Lecturer, (Canadian Institute for Theoretical Astrophysics), June, 1996
1996 Welsh Distinguished Lecturer, University of Toronto, May, 1996
ΣΠΣ Distinguished Lecturer, Villanova University, April, 1996
John Simon Guggenheim Fellowship, 1994-5
Freeman Dyson Fellowship, Institute for Advanced Study, 1995
First Award, Gravitational Research Foundation, for Essay entitled "Gravity's Rainbow," (with G. F.Smoot); 1993
Rose Award for Faculty Supervisor of Most Outstanding Senior Thesis (advisee Rennan Barkana), University of Pennsylvania, 1993
Loeb Lecturer, Harvard University; March, 1991
Second Award, Gravitational Research Foundation, for Essay entitled "New Approaches to Inflationary Cosmology," (with F. S. Accetta); 1990
Monell Foundation Fellowship, Institute for Advanced Study, Princeton, NJ; 1989-90
Frontiers of Science Lecture, University of Utah, April, 1990
Phi Beta Kappa National Visiting Lecturer, 1989-90
Alfred P. Sloan Foundation Fellowship, 1982-86
William Pyle Phillips Lecturer, Haverford College, 1982
Junior Investigator Grant, Department of Energy, 1982-83

## PUBLICATIONS

### Journal Publications

1. "Decagonal and nearly-perfect Quasicrystalline Penrose Tilings in Medieval Islamic Architecture," (with P. Lu), accepted by *Science* (2007).

2. "Cosmic perturbations through the ages," (with J.K. Erickson, S. Gratton and N. Turok), hep-th/0607164.

3. "Why the cosmological constant is small and positive," (with N. Turok), *Science* **312**, 1180-1182, (2006); (and Science Express); astro-ph/0605173.

4. "Solution of a Braneworld Big Crunch/Big Bang Cosmology," (with P. McFadden and N. Turok), hep-th/0512123.

5. "Probing the early universe with inflationary gravitational waves," (with L. Boyle), astro-ph/0512014.

6. "Inflationary predictions for scalar and tensor fluctuations reconsidered," (with L. Boyle and N. Turok), accepted for publication by *Phys. Rev. Lett.*, astro-ph/0503207.

7. "Experimental Measurement of the Photonic Properties of Icosahedral Quasicrystals," (with W. Man, M. Megens, and P. Chaikin), *Nature* **496**, 993-996 (2005).

8. "Controlling Chaos through Compactification in Cosmological Models with a Collapsing Phase," (with D.H. Wesley and N. Turok), *Phys. Rev. D***72**, 063513 (2005); hep-th/0502108.

9. "Dynamical dark energy: Current constraints and forecasts," (with A. Upadhye and M. Ishak), *Phys. Rev. D***72**, 063501 (2005); astro-ph/0411803.

10. "M-theory Model of a Big Crunch/Big Bang Transition," (with N. Turok and M. Perry), *Phys.Rev. D***70** 106004 (2004); hep-th/0408083.

11. "The Cyclic Model Simplified," (with N. Turok) *New Astronomy Reviews* **49**, 43-7 (2005).

12. "Gravitational baryogenesis," (with H. Davoudiasl, R. Kitano, G.D. Kribs, and H. Murayama), *Phys. Rev. Lett.* **93**, 201301 (2004); hep-ph/0403019.

13. "A new duality relating density perturbations in expanding and contracting Friedmann cosmologies," (with L.A. Boyle and N. Turok) *Phys. Rev. D***70** 023504 (2004); hep-th/0403026.

14. "Kasner and mixmaster behavior in universes with equation of state $w|ge1$," (with J. Erickson, D. Wesley, and N. Turok), *Phys. Rev. D***69**, 063514 (2004); hep-th/0312009.

15. "The Cosmic Gravitational-Wave Background in a Cyclic Universe," (with L. Boyle and N. Turok), *Phys. Rev. D***69**, 127302 (2004); hep-th/0307170.

16. "Designing Cyclic Universe Models," (with J. Khoury and N. Turok), *Phys. Rev. Lett.* **92**, 031302 (2004); hep-th/0307132.

17. "Cosmological Perturbations in a Big Crunch/Big Bang Spacetime," (with A. Tolley and N. Turok), *Phys. Rev. D***69**r, 106005 (2004); hep-th/0306109.

18. "Inflation versus Cyclic Predictions for Spectral Tilt," (with J. Khoury and N. Turok), *Phys. Rev. Lett.* **91**, 161301 (2003). astro-ph/0302012.

19. "Conditions for Generating Scale-Invariant Density Perturbations," (with S. Gratton, J. Khoury, and N. Turok), *Phys. Rev. D***69** 103505 (2004); astro-ph/0301395.

20. "Precision Cosmology? Not Just Yet..." (with S.L Bridle, O. Lahav, J.P. Ostriker), *Science* **299**, 1532-3 (2003).

21. "Effects of the Sound Speed of Quintessence on the Microwave Background and Large Scale Structure," (with S. DeDeo and R.R. Caldwell), *Phys. Rev. D***67**, 103509 (2003); astro-ph/0301284.

22. "Rules for Computing Symmetry, Density and Stoichiometry in a Quasi-Unit-Cell Model of Quasicrystals," (with H.-C. Jeong), *Phys. Rev. B***68**, 64102 (2003); cond-mat/0212352.

23. "Sensitivity of the cosmic microwave background anisotropy to initial conditions in quintessence cosmology," (with R. Dave and R. Caldwell), *Phys. Rev. D***66** 023516 (2002); astro-ph/0206372.

24. "Measuring the Speed of Sound of Quintessence," (with J. Erickson, R. Caldwell, V. Mukhanov and C. Armendariz-Picon), *Phys. Rev. Lett.* **88**, 121301 (2001). astro-ph/0112438.

25. "Is Vacuum Decay Significant in Ekpyrotic and Cyclic Models?," (with N. Turok), *Phys. Rev. D***66** 101302 (2002); astro-ph/0112537

26. "Measuring the Equation-of-state of the Universe: Pitfalls and Prospects," (with I. Maor, R. Brustein, and J. McMahon) *Phys. Rev. D***65** 123003 (2002); astro-ph/0112526.

27. "Cosmic Evolution in a Cyclic Universe," (with N. Turok), *Phys. Rev. D***65** 126003 (2002); hep-th/0111098.

28. "A cyclic model of the universe," (with N. Turok), *Science* **296**, 1436 (2002); hep-th/0111030.

29. "Identifying and Indexing Icosahedral Quasicrystals from Powder Diffraction Patterns," (with P. Lu, K. Deffeyes, and N. Yao), *Phys. Rev. Lett.* **87**, 275507 (2002); cond-mat/0108259.

30. "Density Perturbations in the Ekpyrotic Scenario," (with J. Khoury, B. Ovrut and N. Turok), *Phys. Rev. D***66** 046005 (2002); hep-th/0109050.

31. "From Big Crunch to Big Bang," (with J. Khoury, B. Ovrut, N. Seiberg, and N. Turok), *Phys. Rev. D***65** 086007 (2002); hep-th/010818.

32. "Visible Branes with Negative Tension in Heterotic M-Theory," (with R. Donagi, J. Khoury, B. Ovrut and N. Turok), *JHEP* **0111** 041 (2001); hep-th/0105199.

33. "Comment on the Pyrotechnic Universe," (with J. Khoury, B. Ovrut and N. Turok), hep-th/0105212.

34. "Q-ball candidates for self-interacting dark matter," (with A. Kusenko), **Phys. Rev. Lett. 87**, 141301 (2001); astro-ph/0106008.

35. "The Ekpyrotic Universe: Colliding Branes and the Origin of the Hot Big Bang," (with J. Khoury, B. Ovrut and N. Turok), *Phys. Rev.* **D64** 123522 (2001) hep-th/0103239.

36. Comment on "A Quasi-Unit Cell Model for d-$Al_{72}Ni_{20}Co_8$ based on Clusters with Broken 10-fold Symmetry," (with E. Abe, K. Saitoh, H. H. Takakura, A.P. Tsai and H.-C. Jeong), accepted *Phys. Rev. Lett.* **84**, 111, (2000).

37. "Limitations in using luminosity distance to determine the equation-of-state of the universe," (with I. Maor and R. Brustein), *Phys. Rev. Lett.* **86**, 6-9, (2001); astro-ph/0007297.

38. "Essentials of $k$-essence," (with C. Armendariz-Picon and V. Mukhanov), *Phys. Rev. D***63**, 103510 (2001); astro-ph/0006373.

39. "Halo Properties in Cosmological Simulations of Self-interacting Cold Dark Matter," (with R. Davé, D.N. Spergel, and B. Wandelt), *Ap. J.* **547**, 574-589 (2001); astro-ph/0006218.

40. "Inflationary solutions in the brane-world and their geometrical interpretation," (with J. Khoury and D. Waldram), *Phys. Rev. D***63**, 103505-(1-13) (2001); hep-th/0006069.

41. "A Dynamical Solution to the Problem of a Small Cosmological Constant and Late-time Cosmic Acceleration," (with C. Armendariz-Picon and V. Mukhanov), *Phys. Rev. Lett.* **85**, 4438-41 (2000); astro-ph/0004134.

42. "A Cosmological Mechanism for Stabilizing Moduli," (with G. Huey, B.A. Ovrut and D. Waldram), *Phys.Lett. B***476**(2000) 379-386, (2000).

43. "A Simple Method for Computing the Non-Linear Mass Correlation Function with Implications for Stable Clustering," (with R. Caldwell, R. Juskiewicz, and F. Bouchet), *Ap. J.* **547**, L93-96 (2000); astro-ph/9912395.

44. "Observational evidence for self-interacting cold dark matter," (with D.N. Spergel), *Phys. Rev. Lett.* **84**, 3760-3 (2000); astro-ph/9909386.

45. "A Quasi-Unit Cell Model for d-$Al_{72}Ni_{20}Co_8$ based on Clusters with Broken 10-fold Symmetry," (with E. Abe, K. Saitoh, H. H. Takakura, A.P. Tsai and H.-C. Jeong), *Phys. Rev. Lett.* **84**, 4609 (2000); cond-mat/9907160.

46. "General considerations of the cosmological constant and the stabilization of moduli in the brane-world picture," *Phys.Lett. B***462**, 41-47 (1999).

47. "Improved quasi-unit cell model of $AlNiCo$," (with H.-C. Jeong, K. Saitoh, M. Tanaka, E. Abe, and A.P. Tsai), *Nature* **396**, 55-77 (1998).

48. "A tracker solution to the cold dark matter cosmic coincidence problem," (with I. Zlatev), *Phys. Lett. B***459**, 570-574 (1999).

49. "Cosmic Concordance and Quintessence," (with L. Wang, R. Caldwell, and J.P. Ostriker), *Ap.J.*, **530**, 17-35 (2000).

50. "Cosmological Tracking Solutions," (with L. Wang and I. Zlatev), *Phys. Rev. D***59**, 123504 (1999).

51. "The Cosmic Triangle: Revealing the State of the Universe," N. Bahcall, J.P. Ostriker, S. Perlmutter and P.J. Steinhardt, *Science* **284**, 1481-1488 (1999).

52. "Quintessence, Cosmic Coincidence, and the Cosmological Constant," (with I. Zlatev and L. Wang), *Phys. Rev. Lett.* **82**, 896-899 (1999).

53. "Experimental verification of the quasi-unit-cell model of quasicrystal structure," (with H.-C. Jeong, K. Saitoh, M. Tanaka, E. Abe, and A.P. Tsai), *Nature* **396**, 55-57 (1998).

54. "Resolving the Missing Energy Problem," (with G. Huey, L. Wang, R. Dave, and R. R. Caldwell), *Phys. Rev. D***59**, 063005, 6 pp. (1999).

55. "Cluster Abundance Constraints on Quintessence Models," (with L. Wang), *Ap. J.* **508**, 483-490 (1998).

56. "The Imprint of Gravitational Waves in Models Dominated by a Dynamical Cosmic Scalar Field," (with R.R. Caldwell) *Phys.Rev. D***57** 6057-6064 (1998).

57. "Density Perturbations in Multifield Inflationary Models," (with V.F. Mukhanov) *Phys. Lett. B***422** 52-60 (1998).

58. "Cosmological Imprint of an Energy Component with General Equation-of-State," (with R.R. Caldwell and R. Dave), *Phys. Rev. Lett.* **80**, 1582 (1998).

59. "Parametric Resonance in an Expanding Universe," (with I. Zlatev and G. Huey), *Phys. Rev. D***57** 2152-2157 (1998).

60. "On the Problem of Predicting Inflationary Perturbations," (with L. Wang and V.F. Mukhanov), *Phys. Lett. B***414**, 18-27 (1997).

61. "Constructing Penrose-like Tilings from a Single Proto-tile and the Implications for Quasicrystals," (with H.-C. Jeong) *Phys. Rev B***55**, 3520-3532 (1997).

62. " A simpler approach to Penrose tiling with implications for quasicrystal formation," (with H.-C. Jeong) *Nature* 382, 433-5 (1996).

63. "Regarding the Deceleration and Missing Energy of the Universe," Scientific Correspondence to *Nature* **382**, 768-9 (1996).

64. "The observational case for a low-density Universe with a non-zero cosmological constant," (with J.P. Ostriker) Letters to *Nature* **377**, 600 (1995).

65. "Modular Cosmology," (with T. Banks, M. Berkooz, S. Shenker, and G. Moore), *Phys.Rev.D***52**, 3548-3562,(1995).

66. "The Cosmological Moduli Problem, Supersymmetry Breaking , and Stability in Postinflationary Cosmology," (with T. Banks and M. Berkooz), *Phys.Rev.D***52**, 705-716, (1995).

67. "High Frequency Oscillations of Newton's Constant Induced by Inflation," (with C. M. Will), *Phys. Rev.* **D**52, 628-639 (1995).

68. "How Well Can Cosmological Parameters Be Estimated From Cosmic Microwave Background Observations," (with J.R. Bond and R.L. Davis), *Astro. Lett. & Comm.* **32**, 53-62 (1995).

69. "A Cluster Approach for Quasicrystals," (with H.-C. Jeong), *Phys. Rev. Lett.* **73**, 1943 (1994).

70. "Measuring Cosmological Parameters with Cosmic Microwave Background Experiments," (with R. Crittenden, J.R. Bond, R. Davis, and G. Efstathiou) *Phys. Rev. Lett.* **72**, 13-16 (1994).

71. "Ising-like Transition and Phason Unlocking in Icosahedral Quasicrystals," (with T. Dotera), *Phys. Rev. Lett.* **72**, 1670-3 (1994).

72. "Polarization of the Microwave Background due to Primordial Gravitational Waves," (with R. Crittenden and R. Davis) *Astrophys. J. Lett.* **417**, L13-18 (1993).

73. "Finite Temperature Elasticity Transition in Decagonal Quasicrystals," (with H.-C. Jeong) *Phys. Rev. B***48**, 9394-403 (1993).

74. "The Imprint of Gravitational Waves on the Cosmic Microwave Background," (with R. Crittenden, J.R. Bond, R.L. Davis, and G. Efstathiou) *Phys. Rev. Lett.* **71**, 324-7 (1993).

75. "Challenges for Superstring Cosmology," (with R. Brustein) *Phys. Lett. B***302**, 196-201 (1993).

76. "Recent Advances in Extended Inflationary Cosmology," *Class. and Quantum Grav.* **10**, S33-S48 (1993).

77. "Cosmic Microwave Background Probes Models of Inflation," (with R. Davis, H. Hodges, G. Smoot and M. Turner), *Phys. Rev. Lett.* **69** 1856-59 (1992).

78. "Graceful Exit in Extended Inflation and Implications for Density Perturbations," (with R. Crittenden) *Physics Letters B***293**, 32-36 (1992).

79. "New Constraints and Improvements on Oscillating Physics," (with R. Crittenden), *Astro. J.* **395**, 360-5 (1992).

80. "Cosmological Consequences of High Frequency Oscillations of Newton's Constant," (with F. S. Accetta), *Phys. Rev. Lett.* **67**, 298-301 (1991).

81. "Coherent Peculiar Velocities and Periodic Red Shifts," (with C. T. Hill and M. S. Turner), *Astro. J.*, L57-60 (1991).

82. "Can Oscillating Physics Explain an Apparently Periodic Universe?" (with C. T. Hill and M. S. Turner), *Phys. Lett. B***252**, 343-348 (1990).

83. "New Approaches to Inflationary Cosmology," (with F. S. Accetta), *General Relativity and Gravitation* **23**, 1-5 (1991).

84. "Hyperextended Inflation," (with F.S. Accetta), *Phys. Rev. Lett.* **63**, 2740-3 (1990).

85. "Inflation and the Ω-Problem," *Nature 345*, 41 (1990). (Article Reviewed in *News and Views* in the same issue.)

86. "Matching Rules and Growth Rules for Pentagonal Quasicrystal Tilings," (with K. Ingersent) *Phys. Rev. Lett.* **64**, 2034-7 (1990).

87. "Prescription for Successful Extended Inflation," (with D. La and E. Bertschinger) *Phys. Lett. B* **231**, 231-4 (1989).

88. "Comment on a Paper by L. Pauling," (with P. Bancel, P. Heiney, and P. Horn), *PNAS* **86**, 8600-1 (1989).

89. "Bubble Nucleation for Flat Potentials," (with L. Jensen) *Nucl. Phys. B***317**, 693-705 (1989).

90. "Bubble Percolation in Extended Inflationary Models," (with D. La) *Phys. Lett.* **220**, 375-8 (1989).

91. "Reply to *Local Growth of Quasicrystals*," (with G. Onoda, D. DiVincenzo, and J. Socolar) *Phys. Rev. Lett.* **62**, 1210 (1989).

92. "Extended Inflationary Cosmology," (with D. La) *Phys. Rev. Lett.* **62**, 376-9 (1989).

93. "Comment on *Icosahedral Ordering in Lennard-Jones Liquid and Glass*," (with D. Nelson) *Phys. Rev. Lett.* **62**, 978 (1989).

94. "Equilibrium Faceting Shapes for Quasicrystals," (with K. Ingersent) *Phys. Rev. B***39**, 980-992 (1989).

95. "Growing Perfect Quasicrystals," (with G. Onoda, D. DiVincenzo, and J. Socolar) *Phys. Rev. Lett.* **60**, 2653-6 (1988).

96. "Quasicrystals with Dodecahedral Equilibrium Faceting," (with K. Ingersent) *Phys. Rev. Lett.* **60**, 2444 (1988).

97. "Icosahedral Solids: A New Phase of Matter?," *Science* **238**, 1242-1247 (1987). (Invited Article)

98. "Quasicrystallinity of Icosahedral $Pd_{58.8}U_{20.6}Si_{20.6}$," (with D. D. Kofalt, I. A. Morrison, T. Egami, S. Preische and S. J. Poon) *Phys. Rev.* B**35**, 4489-4492 (1987).

99. "Distinguishing a Quasicrystal from an Icosahedral Glass via High Resolution Lattice Imaging," *Phys. Rev. Lett.* **57**, 2769(C) (1986).

100. "Phonons, Phasons and Dislocations in Quasicrystals," (with J. E. S. Socolar and T. C. Lubensky) *Phys. Rev. B***34**, 3345-60 (1986).

101. "Distortion and Peak Broadening in Quasicrystal Diffraction Patterns," (with J. E. S. Socolar, T. C. Lubensky, P. A. Bancel, and P. A. Heiney) *Phys. Rev. Lett.* **57**, 1440-3 (1986).

102. "Quantum Corrections and Locally Supersymmetric Inflationary Models," (with P. R. Lindblom and B. A. Ovrut) *Phys. Lett.* **172**, 309-12 (1986).

103. "Quasicrystals I: Definition and Structure," (with D. Levine) *Phys. Rev. B***34**, 596-616 (1986).

104. "Quasicrystals II: Unit Cell Configurations," (with J. Socolar) *Phys. Rev. B***34**, 617-647 (1986).

105. "Quasicrystals with Arbitrary Orientational Symmetry," (with J. Socolar and D. Levine) *Phys. Rev.* B**32**, 5547-51 (1985).

106. "Elasticity and Dislocations in Pentagonal and Icosahedral Quasicrystals," (with D. Levine, T. Lubensky, S. Ostlund, S. Ramaswamy, and J. Toner) *Phys. Rev. Lett.* 54: 1520-3 (1985).

107. "Quasicrystals: A New Class of Ordered Structures," (with D. Levine) *Phys. Rev. Lett.* 53: 2477-80 (1984).

108. "Thermal Production of Superheavy Magnetic Monopoles in the New Inflationary Universe Scenario," (with P. Lindblom) *Phys. Rev. D*31: 2151-4 (1985).

109. "Supersymmetric Inflation, Baryon Asymmetry and the Gravitino Problem," (with B. Ovrut) *Phys. Lett.* 147B: 263-8, (1984).

110. "Locally Supersymmetric Cosmology and the Gauge Hierarchy," (with B. Ovrut) *Phys. Rev. D*30: 2061-6 (1984).

111. "Inflationary Cosmology and the Mass Hierarchy in Locally Supersymmetric Theories," (with B. Ovrut) *Phys. Rev. Lett.* 53: 732-5 (1984).

112. "A Prescription for Successful New Inflation," (with M. Turner) *Phys. Rev. D*29, 2162-71 (1984).

113. "Supersymmetry and Inflation: A New Approach," (with B. Ovrut) *Phys. Lett.* 133B, 161-8 (1983).

114. "Bubble Nucleation and the Coleman-Weinberg Model," (with L. Jensen) *Nucl. Phys. B*237, 176-88 (1984).

115. "Inflation in SU(5) GUT Models Coupled to Gravity," (with A. Albrecht and L. Jensen) *Nucl. Phys. B*239, 290-300 (1984).

116. "Saving the Invisible Axion," (with M. Turner) *Phys. Lett.* 129B, 51 (1983).

117. "Inflation and Supersymmetry," (with A. Albrecht) *Phys. Lett.* 131B: 45-8 (1983).

118. "New Inflation in Supersymmetric Theories," (with A. Albrecht, S. Dimopoulos, W. Fischler, E. Kolb, and S. Raby) *Nucl. Phys. B*229, 528-40 (1983).

119. "Bond Orientational Order in Liquids and Glasses," (with M. Ronchetti and D. Nelson) *Phys. Rev. B*28, 784-805 (1983).

120. "Spontaneous Creation of Almost Scale-Free Density Perturbations in an Inflationary Universe," (with J. Bardeen and M. Turner) *Phys. Rev. D*28, 679-93 (1983).

121. "Dissociation of Abrikosov-Nielsen-Olesen Vortices," (with L. Jensen) *Phys. Rev. B*27, 5549-56 (1982).

122. "Reheating an Inflationary Universe," (with A. Albrecht, M. Turner and F. Wilczek) *Phys. Rev. Lett.* 48, 1437-40 (1982).

123. "Cosmology of Grand Unified Theories with Radiatively Induced Symmetry Breaking," (with A. Albrecht) *Phys. Rev. Lett.* 48, 1220-3 (1982).

124. "Relativistic Detonation Waves and Bubble Growth in False Vacuum Decay," *Phys. Rev. D*25, 2074-85 (1982).

125. "Displacement Vector and Energy of a Screw Dislocation in a Lennard- Jones Amorphous Solid," (with P. Chaudhari) *Phil. Mag. A*46, 25-30 (1982).

126. "Icosahedral Bond Orientational Order in Supercooled Liquids," (with M. Ronchetti and D. Nelson) *Phys. Rev. Lett.* 47, 1297-300 (1981).

127. "Monopole Dissociation in the Early Universe," *Phys. Rev. D*24, 842-57 (1981).

128. "Monopole and Vortex Dissociation and Decay of the False Vacuum," *Nucl. Phys. B*190 [FS3] 583-616 (1981).

129. "The Airy Stress Function for Atomic Models," (with P. Chaudhari) *J. of Comp. Phys.* 42, 266-76 (1981).

130. "The Weinberg-Salam Model and Early Cosmology," *Nucl. Phys. B*179, 492-508 (1981).

131. "Point and Line Defects in Glasses," (with P. Chaudhari) *Phil. Mag.* 44, 1375-81 (1981).

132. "Two-Dimensional Gauge Theories with Diagonal SU(N) Color," *Ann. of Phys.* 132, 18-31 (1981).

133. "Vacuum Instability and Refined Limits on the Higgs Meson Mass," *Phys. Lett.* 97B, 147-50 (1980).

134. "Baryons and Baryonium in Two-Dimensional QCD," *Nucl. Phys. B*176, 100-12 (1980).

135. "Problems of Quantization in the Infinite Momentum Frame," *Ann. of Phys.* 128, 425-47 (1980).

136. "Four-Quark Static Bag in Two-Dimensions," *Phys. Rev. D*21, 2390-405 (1980).

137. "Edge and Screw Dislocations in an Amorphous Solids," (with P. Chaudhari and A. Levi) *Phys. Rev. Lett.* 43-7, 1517 (1979).

138. "On the Stability a of Vacancy and Vacancy Clusters in Amorphous Solids," (with C. Bennett, P. Chaudhari, and V. Moruzzi) *Phil. Mag.* 40, 485-95 (1979).

139. "Quark Liberation in (1 + 1)-Dimensions," (with S. Parke) *Ann. of Phys.* 114, 215-22 (1978).

140. "SU(2) Flavor Schwinger Model in (1 + 1)-Dimensions," *Phys. Rev. D*16, 1782-90 (1977).

141. "Transformations between Random Networks and Dense Random Packed Models of Amorphous Solids," (with P. Chaudhari, J. F. Graczyk and D. Henderson) *Phil. Mag.* 31, 727-32 (1975).

142. "Junctions between Amorphous and Crystal Silicon," *Phys. Stat. Sol. (b)* 72, 761-70 (1975).

143. "On the Measurement of the Conductivity Density of States of Evaporated Amorphous Silicon Films," (with M. Brodsky) *Phys. Stat. Sol. (b)* 32, 422-40 (1975).

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## PROFESSIONAL SERVICE

Member, Executive Committee for the Council on Science & Technology, Princeton University, 2006-10
Associate Director & Senior Fellow, Princeton Center for Theoretical Physics, 2006-
Member, Class Membership Committee, National Academy of Sciences, 2006
Chair, Astrophysics, Cosmology and Gravity Panel, National Academy of Sciences, 2005-8
Chair, Advisory Board, Perimeter Institute for Theoretical Physics, 2005-
CERN Theory Visiting Committee, 2005-8
NAS EPP2010 Panel on Future of Particle Physics, 2004-5
Co-organizer, Summer School on Prospects in Theoretical Physics, Princeton, NJ; July, 2003

Co-organizer (with M. Davis), National Academy of Sciences Colloquium on Challenges to the Standard Paradigm; November 2-3, 2002

International Advisory Committee, XXIV International Colloquium on Group Theoretical Methods in Physics, Paris, July, 2002

Member, NRC Committee on Astronomy and Astrophysics (CAA), joint committee of the Board on Physics and Astronomy and the Space Studies Board, 2000-2003

NSF Review Selection Panel, 2000

International Advisory Committee, COSMO-2001, Helsinki

International Advisory Committee, 2000 Texas Symposium, Austin, TX; December, 2000

Review Committee, Decadal Report, *Physics in a New Era*, Board on Physics and Astronomy, 2000

Organizer, Meeting on Key Tests for Cosmogenic Theories; Cambridge, UK; December, 1999

DoE Review for SNAP; December, 1999

Chair and Organizer, EC Summer School on Connecting Fundamental Physics and Cosmology; Cambridge, UK; August 16-27, 1999

Organizer; NATA ASI on Structure Formation in the Universe; Cambridge, UK; July, 26 - August 6, 1999

Visiting Committee; Physics, Mathematics & Astronomy Division, Caltech; 1999-

Scientific Advisory Board, *New Astronomy*, Elsevier, 1998-

International Advisory Committee, Cosmo-2000; Seoul, Korea; Sept. 4-8, 2000

International Advisory Board, Canadian Institute for Advanced Research, Cosmology and Gravity Program, 1998-

Co-organizer (w/N. Turok and V. Rubakov), Program on "Large-scale Structure in the Universe;" to take place July 19-Dec. 17, 1999; Newton Mathematical Institute, Cambridge, UK

Co-organizer (w/J. Frieman, S. Dodelson, and R. Caldwell), Workshop on "Missing Energy in the Universe," Fermilab, May, 1998

Member, Special Emphasis Panel for the Theoretical Physics Division of the National Science Foundation, Fall, 1996

Member, URA Visiting Committee for Fermi National Accelerator Laboratory, 1995-8

Member, Cosmology Review Panel of the Canadian Institute for Advance Research (CIAR); 1995-6

Member, Visiting Committee, University of Delaware-Bartol Research Institute; 1995-9

Member, University Scholars Council, University of Pennsylvania, 1996-8

Head, University of Pennsylvania High Energy Theory Group, 1995-8

Dean's Planning and Priorities Committee, University of Pennsylvania; 1995-8

Dean's Consultative Committee, University of Pennsylvania; 1995-8

University of Pennsylvania Freshman Advisor, 1995-8

Member, Special Review Panel of the Department of Energy, Antimatter Spectrometer

Proposal, 1995

Organizer, Cosmology Working Group, Snowmass Workshop on the Future of Astroparticle Physics, June-July, 1994

Member of Faculty Personnel Committee, School of Arts and Sciences at U. of Penn.; 1993-4

Advisory Board for the Institute of Theoretical Physics at U.C. Santa Barbara, 1990-4; [Chair, 1992-3]

School of Arts and Sciences Task Force on Planning, U. of Pennsylvania, 1990-2

Organizer, U. of Pennsylvania Workshop on Growing Perfect Quasicrystals, April, 1989

Natural Sciences Board, University of Pennsylvania, 1987-8

Editorial Board, Journal of Modern Physics B, Statistical and Condensed Matter Physics, 1987-90

Dean's Divisional Planning Committee for the Natural Sciences, School of Arts and Sciences, 1986-8

Co-organizer (with Prof. S. Bludman) of University of Pennsylvania Minisymposium on Evolution of Structure in the Early Universe; May, 1984

Local Organizing Committee, Fourth Workshop on Grand Unification; Philadelphia, Pennsylvania; April,1983